What is claimed is:

Sub A'

1. A protection switching method for a passive optical network system including

an optical line terminal for switching between a first active-system transmission/reception section and a first standby-system transmission/reception section by using a switch,

a plurality of network unit for selectively connecting second active-system transmission/reception sections and second standby-system transmission/reception sections to subscriber terminals upon switching said sections through selectors in the event of a communication abnormality, and

transmission paths for star-connecting said second active-system transmission/reception sections to said first active-system transmission/reception section, and also star-connecting said second standby-system transmission/reception sections to said first standby-system transmission/reception section,

characterized by comprising the steps of:

detecting a communication abnormality in at least one active-system virtual path established between said optical line terminal and said subscriber terminal through said transmission path and said network unit; and

upon detection of a communication abnormality

in the active-system virtual path, causing said switch to switch the transmission paths to establish a standby-system virtual path between said optical line terminal and said subscriber terminal serving as a communication partner.

2. A method according to claim 1, wherein the method further comprises the step of simultaneously transmitting warning signals indicating communication abnormalities from said network units, and the step of establishing comprises the step of simultaneously switching a plurality of active-system virtual paths between said optical line terminal and said subscriber terminals to a plurality of standby-system virtual paths by simultaneously switching/controlling all ports of said switch in said optical line terminal upon reception of the warning signals.

3. A method according to claim 1, wherein the method further comprises the step of simultaneously transmitting warning signals indicating communication abnormalities from said network units which have accessed signals distributed from said optical line terminal, and the step of establishing comprises the step of simultaneously switching a plurality of active-system

virtual paths between said optical line terminal and said subscriber terminals to a plurality of standby-system virtual paths by simultaneously switching/controlling predetermined ports of said switch in said optical line terminal upon reception of the warning signals.

4. A method according to claim 1, further comprising the steps of:

transmitting a selector switching signal from said optical line terminal to said network unit when a communication abnormality in the active-system virtual path is detected; and

selectively switching said active-system transmission/reception section and said standby-system transmission/reception section in said network unit when the selector switching signal is received.

5. A method according to claim 1, further comprising the step of setting an active-system virtual path and a standby-system virtual path between said optical line terminal and said subscriber terminal in different bands.

6. A method according to claim 1, wherein

the method further comprises the step of setting, in different bands, a plurality of first

active-system virtual paths running through said first and second active-system transmission/reception sections, a plurality of second active-system virtual paths running through said first and second standby-system transmission/reception sections, first standby-system virtual paths running through said first and second active-system transmission/reception sections, and second standby-system virtual paths running through said first and second standby-system transmission/reception sections, and

the step of establishing comprises the step of switching the virtual path to one of the first and second standby-system virtual paths through said switch when a communication abnormality is detected in one of the first and second active-system virtual paths.

7. A method according to claim 6, further comprising the step of resetting the second active-system virtual path and the second standby-system virtual path to share a band assigned to said first active-system transmission/reception section when communication abnormalities are detected in all said first active-system virtual paths.

8. A method according to claim 6, further comprising the step of resetting the first active-system virtual path and the first standby-system virtual path

to share a band assigned to said first active-system transmission/reception section when communication abnormalities are detected in all said second active-system virtual paths.

9. A method according to claim 1, wherein the method further comprises the step of setting a plurality of active-system virtual paths in different bands, and

the step of establishing comprises the step of, when a communication abnormality occurs in one of the active-system virtual paths, limiting a band set for the remaining normal active-system virtual paths and using a surplus band as a standby-system virtual path.

or

10. A method according to claim 1, wherein the method further comprises the step of setting a plurality of active-system virtual paths and a plurality of standby-system virtual paths, and

the step of establishing further comprises the step of switching active-system virtual paths, except for an active-system virtual path assigned to a specific subscriber terminal for which no protection is required, to standby-system virtual paths, except for a standby-system virtual path assigned to said specific subscriber terminal, in the even of communication abnormalities in the active-system virtual paths except

for the active-system virtual path assigned to said specific subscriber terminal.

11. A method according to claim 1, wherein the method further comprises the steps of:

setting a plurality of active-system virtual paths between said subscriber terminal and a plurality of first transmission/reception means corresponding to said active-system transmission/reception section; and

setting a standby-system virtual path between said subscriber terminal and second transmission/reception means corresponding to said stanby-system transmission/reception section, and

the step of establishing comprises the step of, when an abnormality is detected in an active-system virtual path, switching the active-system virtual path in which the abnormality is detected to a standby-system virtual path by using a band held by said second transmission/reception means.

12. A protection switching apparatus for a PON system characterized by comprising:

an optical line terminal having a first active-system transmission/reception section and a first standby-system transmission/reception section for transmitting/receiving signals and detecting communication abnormalities in transmission paths;

a plurality of network units each having a second active-system transmission/reception section and a second standby-system transmission/reception section respectively connected to said first active-system transmission/reception section and said standby-system transmission/reception section through the transmission paths, said network units being star-connected to said optical line terminal through the transmission paths;

selectors which are respectively arranged in said network units to select said second active-system transmission/reception section and said second standby-system transmission/reception section connected to normal transmission paths, one of said selected second active-system transmission/reception section and said selected second standby-system transmission/reception section being connected to subscriber terminals;

a switch which is arranged in said optical line terminal to establish a virtual path between said optical line terminal and said network unit by switching and connecting the transmission path between said first active-system transmission/reception section and said first standby-system transmission/reception; and

a first control section which is arranged in said optical line terminal to control said switch, upon detection of a communication abnormality in the transmission path, so as to switch the abnormal

transmission path to a normal transmission path, thereby reestablishing a virtual path to said subscriber terminal in which the communication abnormality has occurred, the virtual path being constituted by an active-system virtual path and a standby-system virtual path.

13. An apparatus according to claim 12, wherein the transmission path is formed from a metal line.

14. An apparatus according to claim 12, wherein the transmission path is formed from a coaxial cable.

15. An apparatus according to claim 12, wherein the transmission path is an optical transmission path, and said network unit is an optical network unit.

16. An apparatus according to claim 15, wherein the optical transmission paths respectively star-connect said second active-system transmission/reception section and said second standby-system transmission/reception section to said first active-system transmission/reception section and said first standby-system transmission/reception section through photocouplers.

17. An apparatus according to claim 12, wherein said switch outputs an ATM cell to one of a plurality of ports, to which said first active-system transmission/reception section and said first standby-system transmission/reception section are connected, in accordance with a header value added to the ATM cell.

18. An apparatus according to claim 12, wherein said switch determines an output port for data in a synchronous transfer mode in accordance with a time slot of a frame.

19. An apparatus according to claim 12, wherein

said network units transmit warning signals indicating communication abnormalities in the transmission paths, and

said first control section switches/controls all ports of said switch to simultaneously switch virtual paths between said optical line terminal and said subscriber terminals from active-system virtual paths to standby-system virtual paths upon simultaneously receiving the warning signals from said network units.

20. An apparatus according to claim 12, wherein

said network units which have accessed signals

distributed from said optical line terminal transmit warning signals indicating communication abnormalities in the transmission paths, and

said first control section switches/controls predetermined ports of said switch to simultaneously switch virtual paths between said optical line terminal and said subscriber terminals from active-system virtual paths to standby-system virtual paths upon simultaneously receiving the warning signals from said network units.

21. An apparatus according to claim 12, wherein

said first control section transmits a selector switching signal to said network unit when a communication abnormality is detected in the transmission path, and

said network unit comprises a second control section for controlling said selector to selectively switch said second active-system transmission/reception section and said second standby-system transmission/reception section upon reception of the selector switching signal from said optical line terminal.

22. An apparatus according to claim 12, wherein the active-system virtual path and the standby-system virtual path between said optical line terminal and said

subscriber terminal are set in different bands.

23. An apparatus according to claim 12, wherein the virtual path comprises a plurality of first active-system virtual paths running through said first and second transmission/reception sections, a plurality of second active-system virtual paths running through said first and second standby-system transmission/reception sections, a first standby-system virtual path running through said first and second active-system transmission/reception sections, and a second standby-system virtual path running through said first and second standby-system transmission/reception sections, the first and second active-system virtual paths and the first and second standby-system virtual paths being set in different bands, and

said first control section controls said switch to switch the virtual path to one of the first and second standby-system virtual paths when a communication abnormality is detected in one of the first and second active-system virtual paths.

24. An apparatus according to claim 23, wherein when communication abnormalities are detected in all the first active-system virtual paths, a second active-system virtual path and a second standby-system virtual path are reset to share a band assigned to said

first standby-system transmission/reception section.

25. An apparatus according to claim 23, wherein when communication abnormalities are detected in all the second active-system virtual paths, a first active-system virtual path and a first standby-system virtual path are reset to share a band assigned to said first active-system transmission/reception section.

26. An apparatus according to claim 12, wherein

a plurality of active-system virtual paths are set in different bands, and

when a communication abnormality is detected in an active-system virtual path, a band set for remaining normal active-system virtual paths is limited, and a surplus band is used as a standby-system virtual path.

27. An apparatus according to claim 12, wherein

a plurality of active-system virtual paths and a plurality of standby-system virtual paths are set, and

said first control section controls said switch, in the event of communication abnormalities in active-system virtual paths except for an active-system virtual path assigned to a specific subscriber terminal for which no protection is required, so as to switch the active-system virtual paths in which the communication

abnormalities have occurred to standby-system virtual paths except for a standby-system virtual path assigned to said specific subscriber terminal.

28. An apparatus according to claim 12, wherein

a plurality of active-system virtual paths are set between said subscriber terminals and a plurality of first transmission/reception means corresponding to said active-system transmission/reception sections,

a standby-system virtual path forming a virtual path is set between said subscriber terminal and second transmission/reception means corresponding to said stanby-system transmission/reception section, and

when an abnormality is detected in an active-system virtual path, the active-system virtual path in which the abnormality has been detected is switched to a standby-system virtual path by using a band held by said second transmission/reception means.

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